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PROPELLANT SURVEILLANCE REPORT LGM-30 A, B, F & G, STAGE I, TP---ETC(U)  
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OGDEN AIR LOGISTICS CENTER

UNITED STATES AIR FORCE

HILL AIR FORCE BASE, UTAH 84056

LEVEL 1

PROPELLANT  
SURVEILLANCE REPORT  
LGM-30A, B, F & G STAGE 1  
TP - H 1043

PROPELLANT LAB SECTION



MANCP REPORT

NR 424(79)

NOVEMBER 1979

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MANCP ~~REPORT~~ 424(79)  
MMWRM PROJECT M82934C

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PROPELLANT SURVEILLANCE REPORT

LGM-30 A, B, F & G, STAGE I,  
TP-H1043 AFT CLOSURE PROPELLANT.

②

Author

⑩ *John A. Thompson*  
JOHN A. THOMPSON, Chemist

Component & Combustion Test Unit

⑨ Semi-annual rep't;

Engineering & Statistical Review By

*John K Scambia*

JOHN K. SCAMBIA, Project Engineer  
Service Engineering

*Edward J. Erickson*  
EDWARD J. ERICKSON, Statistician  
Data Analysis Unit

Recommended Approval By

*Leonidas A. Brown*

LEONIDAS A. BROWN, Chief  
Component & Combustion Test Unit

*Ronald F. Larsen*  
RONALD F. LARSEN, Chief  
Physical & Mechanical Test Unit

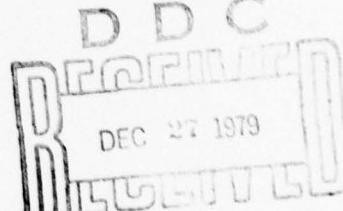
Approved By

*Don F. Woods*

DON F. WOODS, Chief  
Propellant Laboratory Section

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Industrial Products & Ldg Gear Division  
Directorate of Maintenance  
Ogden Air Logistics Center  
United States Air Force  
Hill Air Force Base, Utah 84056

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ABSTRACT

This report contains propellant test results from cartons of TP-H10<sup>43</sup> propellant representing selected batches used in the aft closure of First Stage Minuteman Motors. Data from TP-H10<sup>43</sup> propellant obtained from the aft closures of the LGM-30 A, B, F and G Motors are reported in regression analyses for the fifth time and the fourth time using the G085 computer system. Testing was accomplished in accordance with MMWRME Project M82934C.

An analysis of all parameters indicate that no significant degradation is anticipated for at least two years past the oldest data point.

Each point on the regression plot represents all samples at that particular age. The number of samples at each point is indicated on the sample size summary sheet on the page accompanying each regression plot. The data range at any age can be found by suitable inquiry of the G085 system.

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	LGM-30 First Stage, Wing I Test Reports	
29D	Zero Time Test Results (Aft Closure)	9 Jun 64
29E	Zero Time (Aft Closure Supplement 1)	24 Jun 64
32B	Zero Time, Wings II-V Test Results (Aft Closure)	18 Mar 65
185	ATP Phase I, Wing VI Series III	Jun 70
195	ATP Phase III, Wing II-V	Nov 70
239	Propellant Surveillance Report (TP-H1043)	Apr 72
288	Propellant Surveillance Report (TP-H1043)	Mar 74
337	Propellant Surveillance Report (TP-H1043)	Feb 76

GLOSSARY OF TERMS AND ABBREVIATIONS

Aging Trend	A change in properties or performance resulting from aging of material or component
CSA	Cross Sectional Area
DB	Dogbone
Degradation	Gradual deterioration of properties or performance
E	Modulus (psi), defined as stress divided by strain along the initial linear portion of the curve
EB	End Bonded
EGL	Effective Gage Length
em	Strain at maximum stress
er	Strain at rupture
"F" ratio	The ratio of the variance accounted for by the regression function to the random unexplained variance. The regression function having the most significant "F" ratio is used for plotting data. The ratio is also used in detecting significant changes in random variation between succeeding time points.
JANNAF	Joint Army, Navy, NASA, Air Force Committee
MAGCP	Propellant Lab Section at OOAMA
OOAMA	Ogden Air Materiel Area, Air Force Logistics Command
Regression Equation	The general form of the regression equation is $Y = a + bx$
Regression Line	Line representing mean test values with respect to time
$s_b$	Standard error of estimate of the regression coefficient
$s_e$ or $s_{Y.X}$	Standard deviation of the data about the regression line

GLOSSARY OF TERMS AND ABBREVIATIONS (cont)

SM	Maximum Stress
Sr	Stress at rupture
Standard Deviation(S )	Square root of variance
Strain Rate	Crosshead speed divided by the EGL
"t" test	A statistical test used to detect significant differences between a measured parameter and an expected value of the parameter (determines if regression slope differs from zero at the 95% confidence level)
Variance	The sum of squares of deviations of the test results from the mean of the series after division by one less than the total number of test results
3 Sigma Band	The area between the upper and lower 3 sigma limit. It can be expected that 99.73% of the inventory represented by the test samples would fall within this range assuming that the population is normally distributed.
90-90 Band	It can be stated with 90% confidence that 90% of the inventory represented by the test samples would fall within this range assuming that the population is normally distributed.

## SECTION I

### INTRODUCTION

#### A. PURPOSE:

Quality assurance tests have been conducted for 12 1/2 years on First Stage LGM-30 TP-H1043 aft closure propellant.

Statistical analysis of the tests performed, as directed by Engineering, should provide early warning if serious degradation trends occur. Evaluation of the propellant provides data that can be put directly into engineering reliability and service life predictions. Testing was performed in accordance with MMWRME Directive GTD-1C, Amendments 1 and 2.

#### B. BACKGROUND:

TP-H1043 propellant is used in the aft closure of LGM-30 A, B, F and G First Stage Motors.

This test period represents the fifth time that TP-H1043 propellant has been reported by regression analysis. This is also the fourth time that data has been processed utilizing the GO85 System.

This report represents a large increase in the number of samples tested. Moreover, the age distribution increased to cover a 12 1/2 year time period (4 to 16 1/2 years).

The slope of the respective regressions for this report (Figures 1 thru 14) and the previous reports (1976 and 1977) are very close. The regression slopes of three successive test periods matched very well. This is probably due to the increased number of samples and the stabilizing of post cure chemical changes in the binder.

C. SAMPLING PLAN:

As many as four aft closures are cast from the one TP-H1043 propellant mix. In order to reduce the number of tests, only one batch from each mix will be tested to obtain uniform test results. The selected batches are from the same batch as those previously tested and reported in MAGCP Reports 185(70), 195(70), 239(72), 288(74) and 385(77).

Low rate tensile, high rate tensile and hardness tests were performed on each propellant batch mix.

D. STATISTICAL APPROACH:

Linear regression analysis was used as the method of data evaluation. Data from different time periods were used to establish a least squares trend line for the data. The variance about the regression line, obtained using individual values of the dependent variable, was used to compute a tolerance interval such that at the 90% confidence level, 90% of the sample distribution fall within this interval. This tolerance interval was extrapolated to a maximum of 24 months. The "t" values and the significance of this statistic, which are reported for each regression model, give an indication of the "statistical significance" of the slope of the trend line as compared to a line of zero slope.

Each point on the regression analysis is a calculation of all samples at that particular age. The number of samples at each point is indicated on the sample size summary sheet accompanying each regression plot. The data range at any age can be found by suitable inquiry of the G085 system.

## SECTION II

### TEST RESULTS

#### A. LOW RATE TENSILE:

All of the low rate test parameters show a statistically significant decrease (Figures 1 thru 5). The strain regressions (Figures 1 and 3) show a very gradual decrease. Regression slopes for stresses and modulus (Figures 2, 4 and 5) show a change with respect to time. This change is less than in the previous report. Although all of the regression trends show a decrease, the propellant still shows good stability and from this analysis the propellant will perform satisfactorily for at least two years beyond the last data point.

#### B. HIGH RATE TENSILE:

The strains and maximum stress regressions show a statistically significant decrease. The stress at rupture shows no significant change. The modulus shows a statistically significant increase (Figures 6 thru 10). For those regressions showing a statistically significant change, the slopes are gradual.

#### C. HARDNESS:

Shore A initial hardness test data regressions shows no significant change while the ten second regression shows a statistically significant gradual increase (Figures 11 and 12). The Shore C regressions show a statistically significant decrease (Figures 13 and 14).

SECTION III  
CONCLUSIONS AND RECOMMENDATIONS

The slopes of the regressions are gradual and close to a line of zero slope. From this analysis, no significant degradation seems likely and the propellant service life may be extended for at least two years beyond the date of the last testing.

It is recommended that testing be continued to assure service life extension and confirm the present trend.

\*\*\* SAMPLE SIZE SUMMARY \*\*\*

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
57	3	93	54	119	3	145	15
59	9	94	63	120	15	140	18
60	3	95	33	121	21	147	6
61	6	96	27	122	3	148	15
62	9	97	3	123	12	149	9
63	6	98	5	124	9	150	5
64	3	99	6	126	0	151	3
65	0	101	6	127	3	152	15
66	9	102	5	128	12	154	6
67	0	103	9	129	3	155	5
68	3	104	3	130	9	156	9
72	3	105	6	131	2	157	12
80	3	106	6	132	12	158	12
81	12	107	21	133	18	159	8
82	9	108	33	134	24	160	6
83	15	109	33	135	17	161	12
84	39	110	27	136	21	162	9
85	26	111	33	137	15	163	6
86	29	112	27	138	18	164	9
87	33	113	33	139	9	165	9
88	30	114	26	140	12	166	12
89	56	115	15	141	12	167	17
90	67	116	12	142	12	168	9
91	151	117	5	143	17	169	10
92	144	118	23	144	9	170	12

TENSILE STRAIN AT MAX STRESS (EM), CHS=200 IN/MIN, TP-H1043, WING 2E6

This sample size summary is applicable to figures 1 thru 5

$\gamma = (( +1.475839E-01) + (-4.1923400E-05) * x)$   
 SIGNIFICANCE OF F = SIGNIFICANT  
 SIGNIFICANCE OF R = SIGNIFICANT  
 SIGNIFICANCE OF S = SIGNIFICANT  
 DEGREES OF FREEDOM = 1991  
 TEST CONDITIONS = AMBI TEMP/RH  
 STORAGE CONDITIONS = AMBI TEMP/RH

PARAMETER = STRAIN AT MAX STRESS  
 UNIT OF MEASURE = IN/IN  
 0.00 0.08 0.12 0.16 0.20 0.24

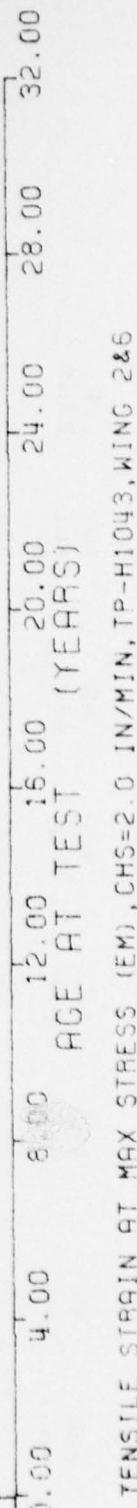


Figure 1

$\text{Y} = ( ( +1.8129326E+02 ) + ( -1.2532990E-01 ) * X )$   
 SIGNIFICANCE OF F = SIGNIFICANT  
 SIGNIFICANCE OF R = SIGNIFICANT  
 SIGNIFICANCE OF S = SIGNIFICANT  
 DEGREES OF FREEDOM = 1992  
 STORAGE CONDITIONS = AMBI TEMP/RH  
 TEST CONDITIONS = AMBI TEMP/RH

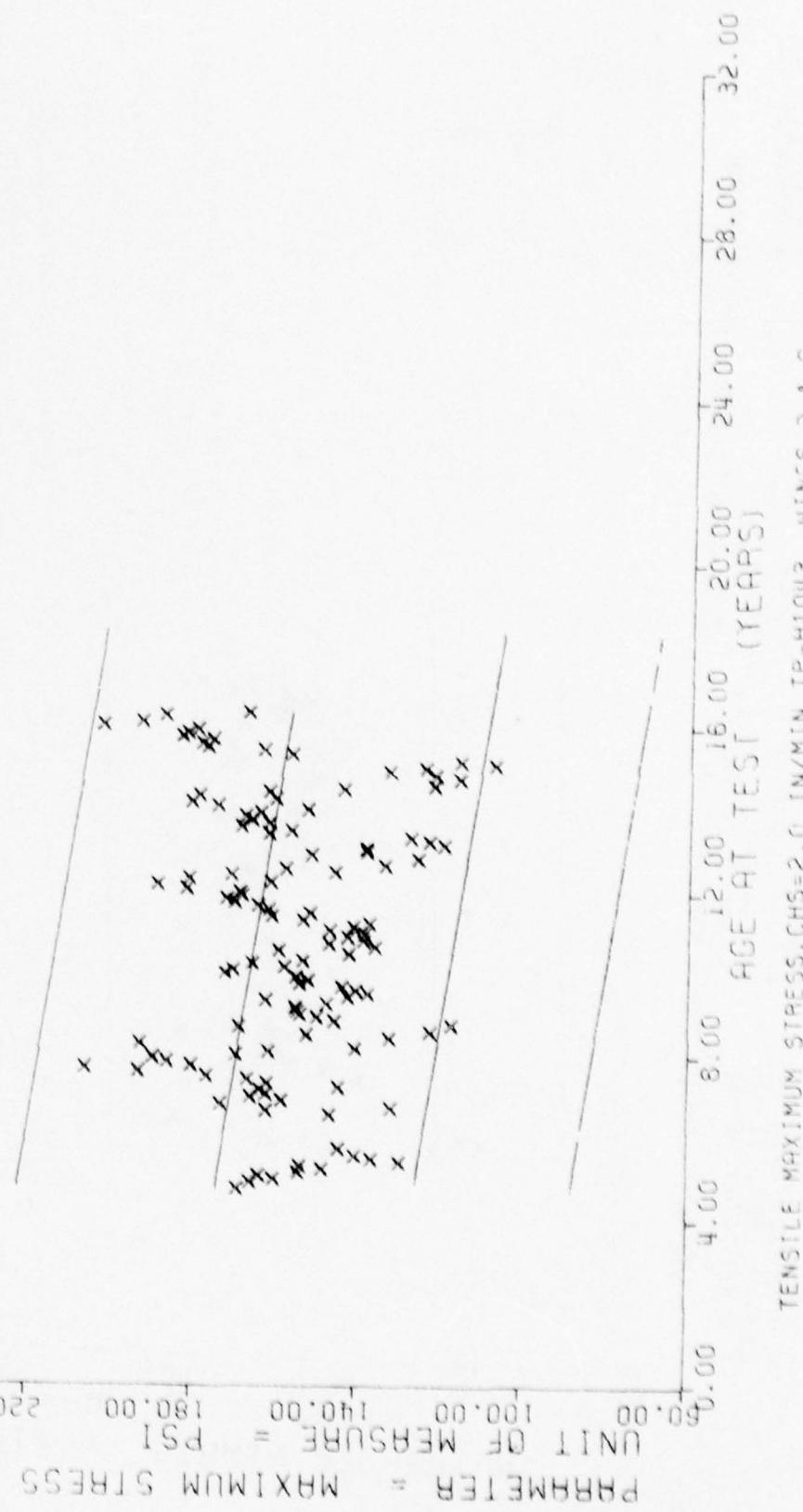
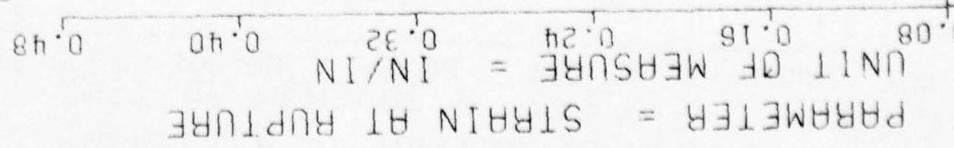


Figure 2

$\gamma = ( +3.0074709E-01 ) + (-9.0614671E-05 ) \times X$   
 $F = \text{SIGNIFICANCE OF } F = \text{SIGNIFICANT}$   
 $\alpha = \text{SIGNIFICANCE OF } \alpha = \text{SIGNIFICANT}$   
 $\beta = \text{SIGNIFICANCE OF } \beta = \text{SIGNIFICANT}$   
 $D = \text{DEGREES OF FREEDOM} = \text{SIGNIFICANT}$   
 $N = \text{STORAGE CONDITIONS} = \text{AMB TEMP/RH}$

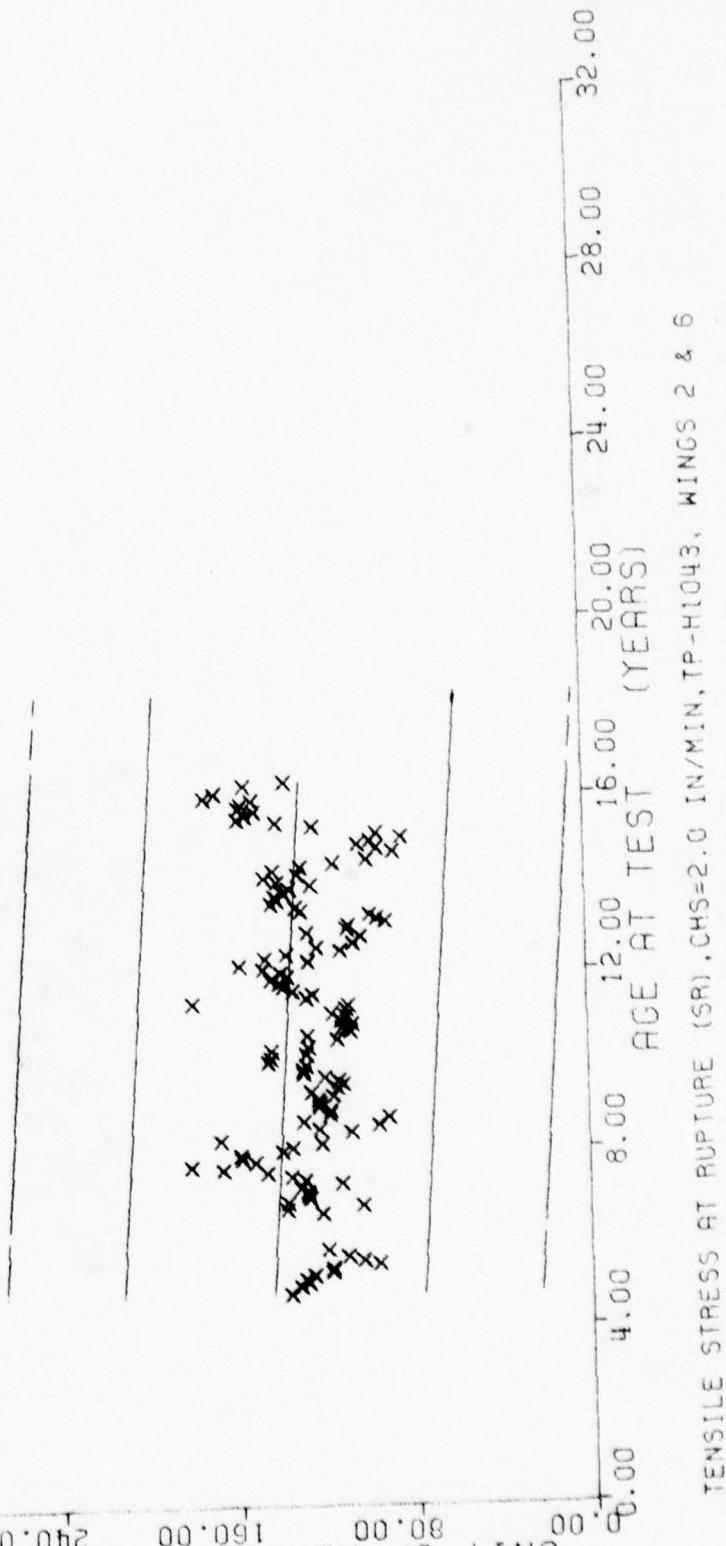


TENSILE STRAIN AT RUPTURE (ER), CHS=2.0 IN./MIN, TP-H1043, WINGS 2 & 6

Figure 3

$\gamma = ( +1.4978493E+02 ) + ( -1.1606704E-01 ) * X$   
 $G_1 = +4.0368978E+01$   
 $S_1 = +2.6182151E-02$   
 $S_2 = +4.0181391E+01$   
 $S_t = +4.0181391E+01$   
 SIGNIFICANT OF F = SIGNIFICANT OF R<sub>1</sub>  
 SIGNIFICANT OF R<sub>2</sub>  
 SIGNIFICANT OF S<sub>t</sub>  
 DEGREES OF FREEDOM = 1992  
 TEST CONDITIONS = AMB TEMP/RH  
 STORAGE CONDITIONS = AMB TEMP/RH

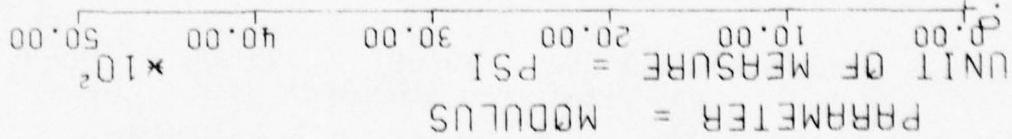
PARAMETER = STRESS AT RUPTURE  
 UNIT OF MEASURE = PSI



TENSILE STRESS AT RUPTURE (PSI), CHS=2.0 IN/MIN, TP-H1043, WINGS 2 & 6

Figure 4

$F = +1.7445490E+01$   
 $R = -9.3199067E-02$   
 $t = +4.1767798E+00$   
 $N = 1993$   
 $\gamma = \text{STORAGE CONDITIONS} = \text{AMB TEMP/RH}$   
 $F = (( +2.5898596E+03 ) + (-1.8722789E+00) ) * X_1$   
 $F = \text{SIGNIFICANCE OF } F = \text{SIGNIFICANT}$   
 $R = \text{SIGNIFICANCE OF } R = \text{SIGNIFICANT}$   
 $t = \text{SIGNIFICANCE OF } t = \text{SIGNIFICANT}$   
 $Degrees of Freedom = 1991$   
 $Test Conditions = \text{AMB TEMP/RH}$



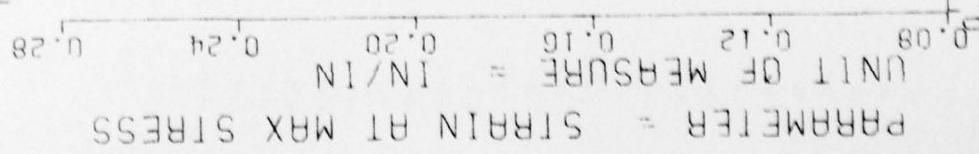
TENSILE MODULUS (E), CHS=2.0 IN/MIN, TP-H1043, WINGS 2 & 6

Figure 5

## TABLE SAMPLE SIZE SUMMARY

TEST	STRESS	AGE (MOS)	TEST SIZE	AGE (MOS)	TEST SIZE	TEST SIZE	TEST SIZE	TEST SIZE	TEST SIZE
27	4.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
28	4.4	<7	1.21	2.1	1.47	6	1.74	1.1	1.1
29	4.5	4.5	1.42	2	1.40	1.1	1.75	9	9
30	4.6	4.4	1.43	1.2	1.49	6	1.76	3	3
31	4.6	3	1.44	2	1.50	7	1.77	6	6
32	4.7	2.1	1.45	4	1.51	6	1.78	6	6
33	4.8	2	1.47	2	1.52	5	1.79	5	5
34	4.9	1.0	1.48	2	1.53	1.1	1.80	1.1	1.1
35	4.9	1.0	1.49	1.2	1.54	6	1.81	1.1	1.1
36	4.9	1.0	1.50	1.2	1.55	1.1	1.82	1.1	1.1
37	5.0	1.0	1.50	1.2	1.55	6	1.83	1.1	1.1
38	5.0	1.0	1.51	1.2	1.56	1.1	1.84	1.1	1.1
39	5.0	1.0	1.52	1.2	1.57	1.1	1.85	1.1	1.1
40	5.0	1.0	1.53	1.2	1.58	1.1	1.86	1.1	1.1
41	5.0	1.0	1.54	1.2	1.59	1.1	1.87	1.1	1.1
42	5.0	1.0	1.55	1.2	1.60	1.1	1.88	1.1	1.1
43	5.0	1.0	1.56	1.2	1.61	1.1	1.89	1.1	1.1
44	5.0	1.0	1.57	1.2	1.62	1.1	1.90	1.1	1.1
45	5.0	1.0	1.58	1.2	1.63	1.1	1.91	1.1	1.1
46	5.0	1.0	1.59	1.2	1.64	1.1	1.92	1.1	1.1
47	5.0	1.0	1.60	1.2	1.65	1.1	1.93	1.1	1.1
48	5.0	1.0	1.61	1.2	1.66	1.1	1.94	1.1	1.1
49	5.0	1.0	1.62	1.2	1.67	1.1	1.95	1.1	1.1
50	5.0	1.0	1.63	1.2	1.68	1.1	1.96	1.1	1.1
51	5.0	1.0	1.64	1.2	1.69	1.1	1.97	1.1	1.1
52	5.0	1.0	1.65	1.2	1.70	1.1	1.98	1.1	1.1
53	5.0	1.0	1.66	1.2	1.71	1.1	1.99	1.1	1.1
54	5.0	1.0	1.67	1.2	1.72	1.1	2.00	1.1	1.1
55	5.0	1.0	1.68	1.2	1.73	1.1	2.01	1.1	1.1
56	5.0	1.0	1.69	1.2	1.74	1.1	2.02	1.1	1.1
57	5.0	1.0	1.70	1.2	1.75	1.1	2.03	1.1	1.1
58	5.0	1.0	1.71	1.2	1.76	1.1	2.04	1.1	1.1
59	5.0	1.0	1.72	1.2	1.77	1.1	2.05	1.1	1.1
60	5.0	1.0	1.73	1.2	1.78	1.1	2.06	1.1	1.1
61	5.0	1.0	1.74	1.2	1.79	1.1	2.07	1.1	1.1
62	5.0	1.0	1.75	1.2	1.80	1.1	2.08	1.1	1.1
63	5.0	1.0	1.76	1.2	1.81	1.1	2.09	1.1	1.1
64	5.0	1.0	1.77	1.2	1.82	1.1	2.10	1.1	1.1
65	5.0	1.0	1.78	1.2	1.83	1.1	2.11	1.1	1.1
66	5.0	1.0	1.79	1.2	1.84	1.1	2.12	1.1	1.1
67	5.0	1.0	1.80	1.2	1.85	1.1	2.13	1.1	1.1
68	5.0	1.0	1.81	1.2	1.86	1.1	2.14	1.1	1.1
69	5.0	1.0	1.82	1.2	1.87	1.1	2.15	1.1	1.1
70	5.0	1.0	1.83	1.2	1.88	1.1	2.16	1.1	1.1
71	5.0	1.0	1.84	1.2	1.89	1.1	2.17	1.1	1.1
72	5.0	1.0	1.85	1.2	1.90	1.1	2.18	1.1	1.1
73	5.0	1.0	1.86	1.2	1.91	1.1	2.19	1.1	1.1
74	5.0	1.0	1.87	1.2	1.92	1.1	2.20	1.1	1.1
75	5.0	1.0	1.88	1.2	1.93	1.1	2.21	1.1	1.1
76	5.0	1.0	1.89	1.2	1.94	1.1	2.22	1.1	1.1
77	5.0	1.0	1.90	1.2	1.95	1.1	2.23	1.1	1.1
78	5.0	1.0	1.91	1.2	1.96	1.1	2.24	1.1	1.1
79	5.0	1.0	1.92	1.2	1.97	1.1	2.25	1.1	1.1
80	5.0	1.0	1.93	1.2	1.98	1.1	2.26	1.1	1.1
81	5.0	1.0	1.94	1.2	1.99	1.1	2.27	1.1	1.1
82	5.0	1.0	1.95	1.2	2.00	1.1	2.28	1.1	1.1
83	5.0	1.0	1.96	1.2	2.01	1.1	2.29	1.1	1.1
84	5.0	1.0	1.97	1.2	2.02	1.1	2.30	1.1	1.1
85	5.0	1.0	1.98	1.2	2.03	1.1	2.31	1.1	1.1
86	5.0	1.0	1.99	1.2	2.04	1.1	2.32	1.1	1.1
87	5.0	1.0	2.00	1.2	2.05	1.1	2.33	1.1	1.1
88	5.0	1.0	2.01	1.2	2.06	1.1	2.34	1.1	1.1
89	5.0	1.0	2.02	1.2	2.07	1.1	2.35	1.1	1.1
90	5.0	1.0	2.03	1.2	2.08	1.1	2.36	1.1	1.1
91	5.0	1.0	2.04	1.2	2.09	1.1	2.37	1.1	1.1
92	5.0	1.0	2.05	1.2	2.10	1.1	2.38	1.1	1.1
93	5.0	1.0	2.06	1.2	2.11	1.1	2.39	1.1	1.1
94	5.0	1.0	2.07	1.2	2.12	1.1	2.40	1.1	1.1
95	5.0	1.0	2.08	1.2	2.13	1.1	2.41	1.1	1.1
96	5.0	1.0	2.09	1.2	2.14	1.1	2.42	1.1	1.1
97	5.0	1.0	2.10	1.2	2.15	1.1	2.43	1.1	1.1
98	5.0	1.0	2.11	1.2	2.16	1.1	2.44	1.1	1.1
99	5.0	1.0	2.12	1.2	2.17	1.1	2.45	1.1	1.1
100	5.0	1.0	2.13	1.2	2.18	1.1	2.46	1.1	1.1
101	5.0	1.0	2.14	1.2	2.19	1.1	2.47	1.1	1.1
102	5.0	1.0	2.15	1.2	2.20	1.1	2.48	1.1	1.1
103	5.0	1.0	2.16	1.2	2.21	1.1	2.49	1.1	1.1
104	5.0	1.0	2.17	1.2	2.22	1.1	2.50	1.1	1.1
105	5.0	1.0	2.18	1.2	2.23	1.1	2.51	1.1	1.1
106	5.0	1.0	2.19	1.2	2.24	1.1	2.52	1.1	1.1
107	5.0	1.0	2.20	1.2	2.25	1.1	2.53	1.1	1.1
108	5.0	1.0	2.21	1.2	2.26	1.1	2.54	1.1	1.1
109	5.0	1.0	2.22	1.2	2.27	1.1	2.55	1.1	1.1
110	5.0	1.0	2.23	1.2	2.28	1.1	2.56	1.1	1.1
111	5.0	1.0	2.24	1.2	2.29	1.1	2.57	1.1	1.1
112	5.0	1.0	2.25	1.2	2.30	1.1	2.58	1.1	1.1
113	5.0	1.0	2.26	1.2	2.31	1.1	2.59	1.1	1.1
114	5.0	1.0	2.27	1.2	2.32	1.1	2.60	1.1	1.1
115	5.0	1.0	2.28	1.2	2.33	1.1	2.61	1.1	1.1
116	5.0	1.0	2.29	1.2	2.34	1.1	2.62	1.1	1.1
117	5.0	1.0	2.30	1.2	2.35	1.1	2.63	1.1	1.1
118	5.0	1.0	2.31	1.2	2.36	1.1	2.64	1.1	1.1
119	5.0	1.0	2.32	1.2	2.37	1.1	2.65	1.1	1.1
120	5.0	1.0	2.33	1.2	2.38	1.1	2.66	1.1	1.1
121	5.0	1.0	2.34	1.2	2.39	1.1	2.67	1.1	1.1
122	5.0	1.0	2.35	1.2	2.40	1.1	2.68	1.1	1.1
123	5.0	1.0	2.36	1.2	2.41	1.1	2.69	1.1	1.1
124	5.0	1.0	2.37	1.2	2.42	1.1	2.70	1.1	1.1
125	5.0	1.0	2.38	1.2	2.43	1.1	2.71	1.1	1.1
126	5.0	1.0	2.39	1.2	2.44	1.1	2.72	1.1	1.1
127	5.0	1.0	2.40	1.2	2.45	1.1	2.73	1.1	1.1
128	5.0	1.0	2.41	1.2	2.46	1.1	2.74	1.1	1.1
129	5.0	1.0	2.42	1.2	2.47	1.1	2.75	1.1	1.1
130	5.0	1.0	2.43	1.2	2.48	1.1	2.76	1.1	1.1
131	5.0	1.0	2.44	1.2	2.49	1.1	2.77	1.1	1.1
132	5.0	1.0	2.45	1.2	2.50	1.1	2.78	1.1	1.1
133	5.0	1.0	2.46	1.2	2.51	1.1	2.79	1.1	1.1
134	5.0	1.0	2.47	1.2	2.52	1.1	2.80	1.1	1.1
135	5.0	1.0	2.48	1.2	2.53	1.1	2.81	1.1	1.1
136	5.0	1.0	2.49	1.2	2.54	1.1	2.82	1.1	1.1
137	5.0	1.0	2.50	1.2	2.55	1.1	2.83	1.1	1.1
138	5.0	1.0	2.51	1.2	2.56	1.1	2.84	1.1	1.1
139	5.0	1.0	2.52	1.2	2.57	1.1	2.85	1.1	1.1
140	5.0	1.0	2.53	1.2	2.58	1.1	2.86	1.1	1.1
141	5.0	1.0	2.54	1.2	2.59	1.1	2.87	1.1	1.1
142	5.0	1.0	2.55	1.2	2.60	1.1	2.88	1.1	1.1
143	5.0	1.0	2.56	1.2	2.61	1.1	2.89	1.1	1.1
144	5.0	1.0	2.57	1.2	2.62	1.1	2.90	1.1	1.1
145	5.0	1.0	2.58	1.2	2.63	1.1	2.91	1.1	1.1
146	5.0	1.0	2.59	1.2	2.64	1.1	2.92	1.1	1.1
147	5.0	1.0	2.60	1.2	2.65	1.1	2.93	1.1	1.1
148	5.0	1.0	2.61	1.2	2.66	1.1	2.94	1.1	1.1
149	5.0	1.0	2.62	1.2	2.67	1.1	2.95	1.1	1.1
150	5.0	1.0	2.63	1.2	2.68	1.1	2.96	1.1	1.1
151	5.0	1.0	2.64	1.2	2.69	1.1	2.97	1.1	1.1
152	5.0	1.0	2.65	1.2	2.70	1.1	2.98	1.1	1.1
153	5.0	1.0	2.66	1.2	2.71	1.1	2.99	1.1	1.1
154	5.0								

$\gamma = (+1.8416192E-01) + (-9.9585191E-05) \times X$   
 $F = \text{SIGNIFICANT}$   
 $D = 1764$   
 $\text{DEGREES OF FREEDOM} = 1764$   
 $\text{STORAGE CONDITIONS} = \text{AMB TEMP/RH}$   
 $\text{TEST CONDITIONS} = \text{AMB TEMP/RH}$   
 $R = +3.3558582E+01$   
 $R = -1.3653457E-01$   
 $R = +5.7929356E+00$   
 $R = 1.766$   
 $N =$



TENSILE STRAIN AT MAX STRESS, CHS=1750.0 IN/MIN, TP-H1043, WINGS 2 & 6

Figure 6

$\gamma = 1.14 \cdot 6920066E+02$        $\beta = -8.34C5223E-02$        $\chi = 7093022E+01$   
 SIGNIFICANCE OF F = SIGNIFICANT  
 SIGNIFICANCE OF R = SIGNIFICANT  
 SIGNIFICANCE OF  $\epsilon$  = SIGNIFICANT  
 DEGREES OF FREEDOM = 1764      TEST CONDITIONS = AMB TEMP/RH  
 STORAGE CONDITIONS = AMB TEMP/RH

UNIT OF MEASURE = PSI      320.00 400.00 480.00 560.00 640.00 720.00  
 PARAMETER = MAXIMUM STRESS

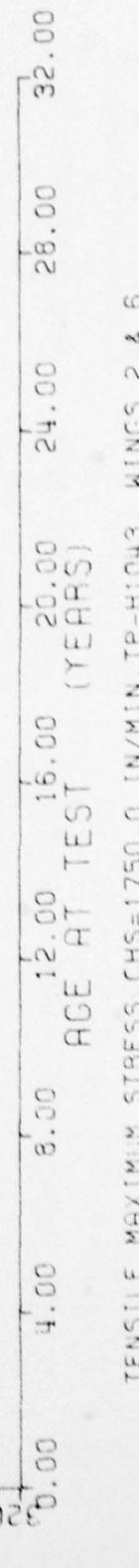


Figure 7

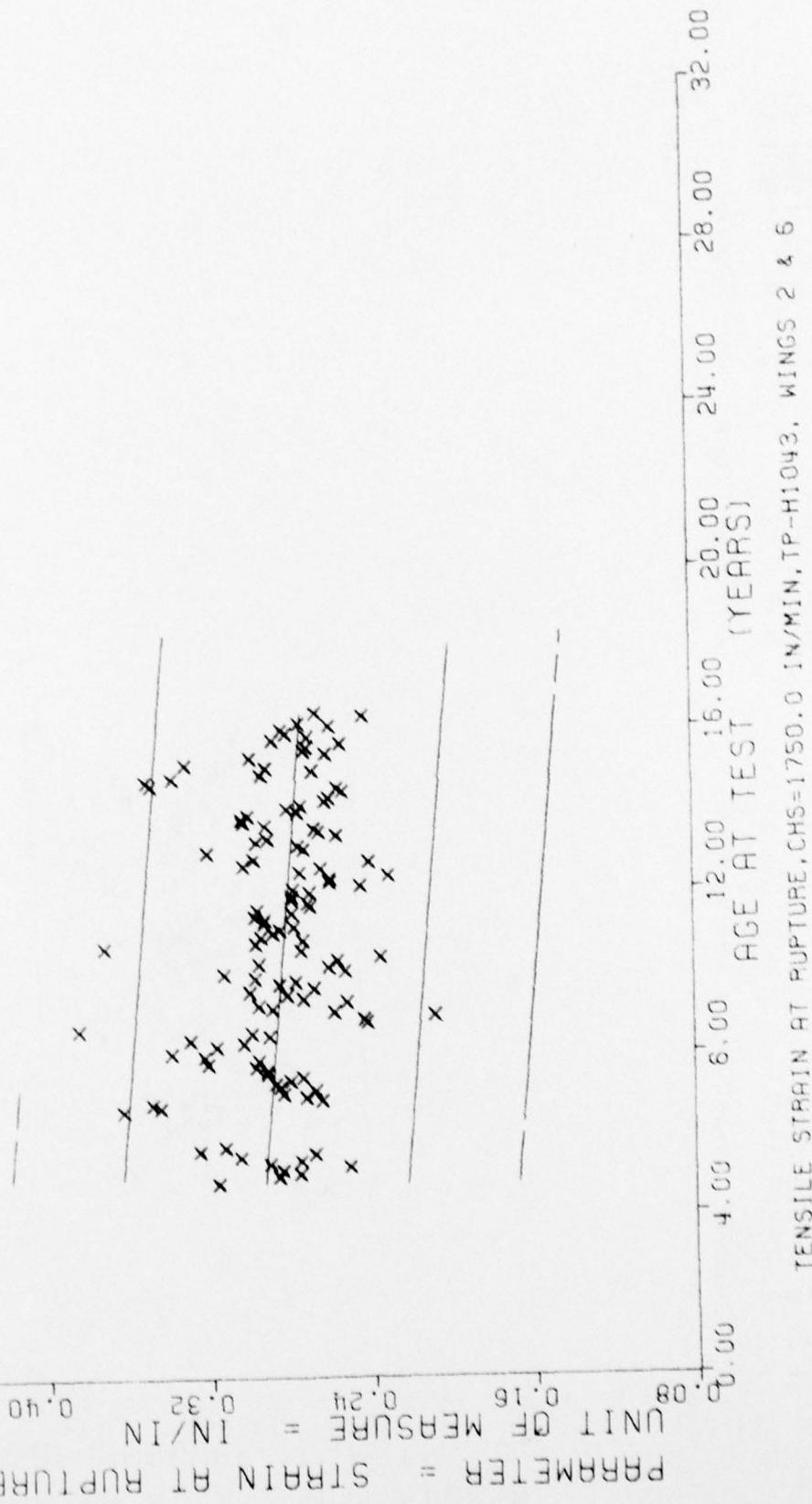
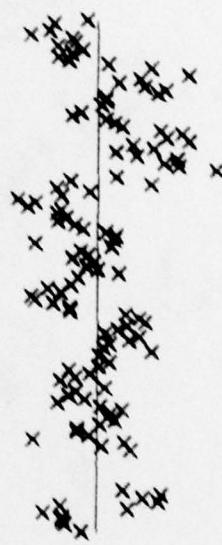


Figure 8

$\gamma = (( +4.0819885E+02) + (-1.3585355E-02)) * X$   
 SIGNIFICANCE OF F = NOT SIGNIFICANT  
 SIGNIFICANCE OF R = NOT SIGNIFICANT  
 SIGNIFICANCE OF t = NOT SIGNIFICANT  
 DEGREES OF FREEDOM = 1764  
 STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH

UNIT OF MEASURE = PSI  
 PARAMETER = STRESS AT RUPTURE  
 0.00 20.00 40.00 60.00 80.00 100.00  $\times 10^4$



0.00 4.00 8.00 12.00 16.00 20.00 24.00 28.00 32.00  
 AGE AT TEST (YEARS)

TENSILE STRESS AT RUPTURE, CHS=1750.0 IN/MIN, TP-H1043, WINGS 2 & 6

Figure 9

$F = +5.4893528E+00$        $\gamma = (+6.4745672E+03) + (+3.6872571E+00)$        $X$   
 $R = +5.5697665E-02$       SIGNIFICANCE OF  $F$  = SIGNIFICANT  
 $t = +2.3429389E+00$       SIGNIFICANCE OF  $R$  = SIGNIFICANT  
 $N = 1766$       DEGREES OF FREEDOM = 1764  
 STORAGE CONDITIONS = AMB TEMP/RH      TEST CONDITIONS = AMB TEMP/RH

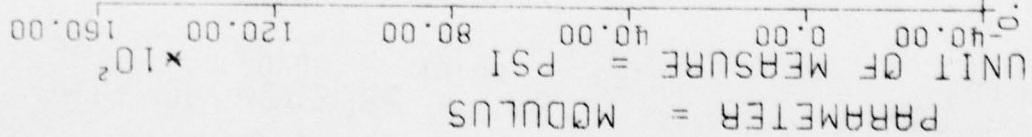


Figure 10

\*\*\* SAMPLE SIZE SUMMARY \*\*\*

AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP	AGE (MOS)	NR SAMP
56	5	92	9	120	20	148	15
58	5	93	6	121	40	149	9
59	10	94	11	123	20	150	5
60	5	95	6	124	13	151	5
61	15	96	3	126	6	152	5
62	10	98	1	127	3	153	5
63	10	99	1	128	12	155	5
64	10	101	10	130	6	156	10
65	10	102	11	131	15	158	25
66	10	103	15	132	19	159	5
67	11	105	10	133	25	160	5
68	5	106	10	134	14	161	15
70	2	107	20	135	17	163	5
80	4	108	30	136	41	164	5
81	4	109	35	137	21	165	10
82	14	110	40	138	3	166	25
83	16	111	25	139	9	167	10
84	25	112	35	140	15	168	15
85	32	113	35	141	9	169	5
86	19	114	35	142	15	170	10
87	24	115	30	143	12	171	15
88	22	116	20	144	8	173	15
89	28	117	15	145	10	174	5
90	14	118	40	146	18	181	10
91	13	119	10	147	3	185	10

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WING 266 HARDNESS SHORE A INITIAL TP-H1043 PROPELLANT

This sample size summary is applicable to figures 11 and 12

$F = +2.0293285E+01$   
 $R = -3.7003924E-02$   
 $t = +1.4245450E+00$   
 $N = 1482$   
 STORAGE CONDITIONS = AMB TEMP/RH  
 TEST CONDITIONS = AMB TEMP/RH

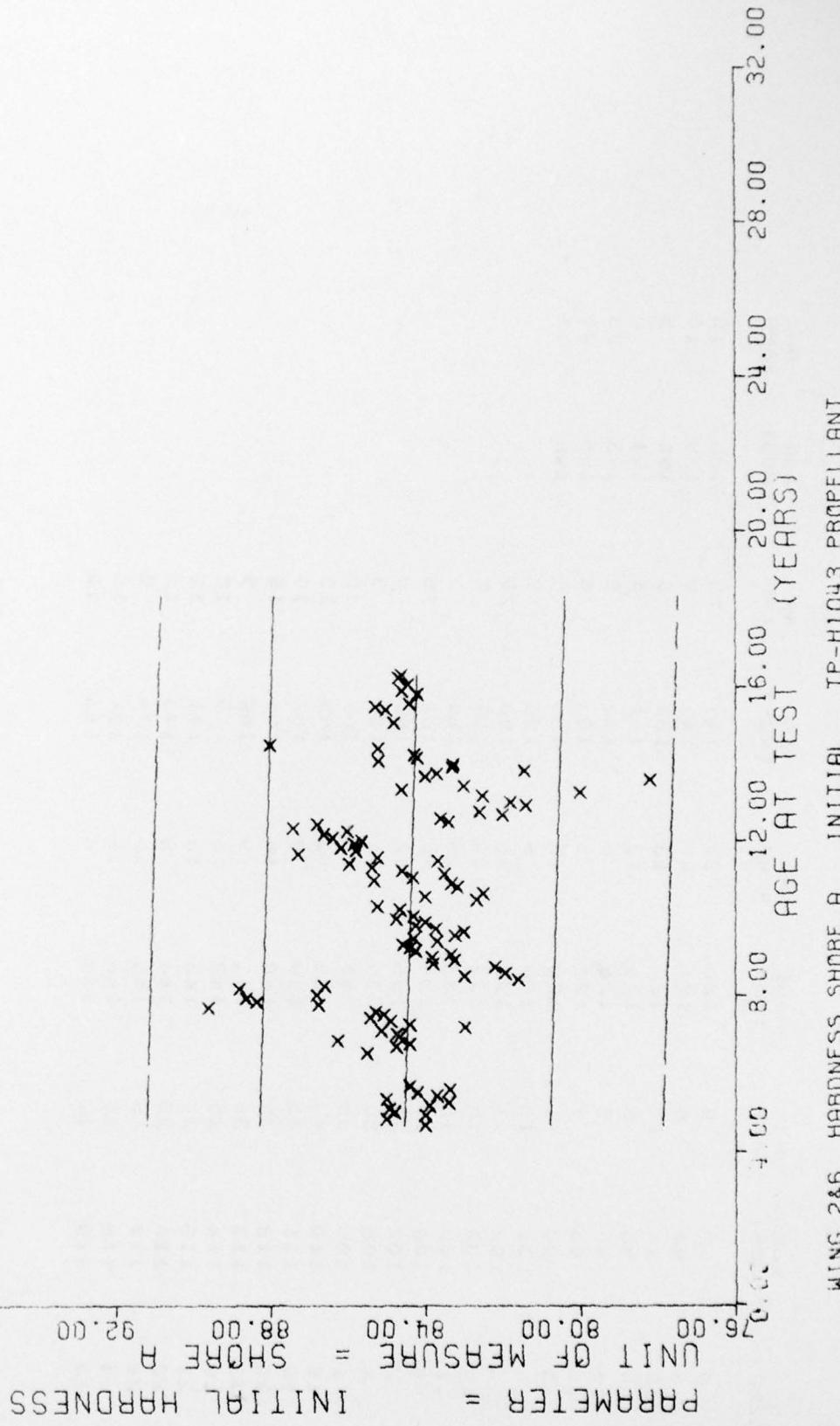


Figure 11

$\gamma = (( +7.5548245E+01) + ( +2.0403561E-02) * X)$   
 $F = 7.9999171E+01$   
 $R = +2.2645429E-01$   
 $t = +8.9442255E+00$   
 $N = 1482$   
 $S T O R A G E \text{ CONDITIONS} = A M B \text{ TEMP/RH}$   
 $D E G R E E S \text{ OF FREEDOM} = 1480$   
 $S I G N I F I C A N T = S I G N I F I C A N T$   
 $S I G N I F I C A N T = S I G N I F I C A N T$   
 $S I G N I F I C A N T = S I G N I F I C A N T$   
 $S I G N I F I C A N T = S I G N I F I C A N T$   
 $C_f = +3.0903943E+00$   
 $S_a = +2.2811993E-03$   
 $S_t = +3.0111282E+00$   
 $T E S T \text{ CONDITIONS} = A M B \text{ TEMP/RH}$

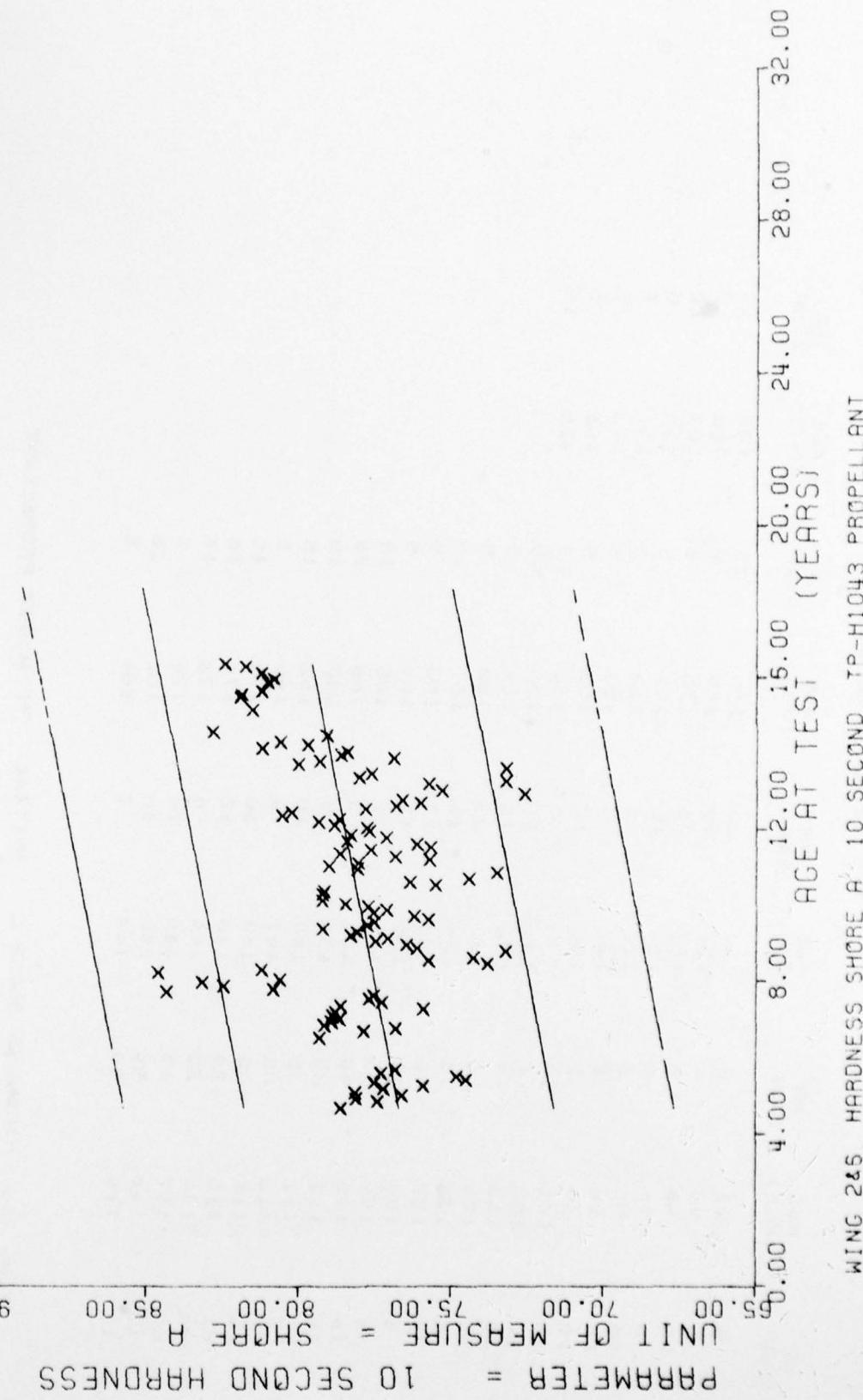


Figure 12

\*\*\* SAMPLE SIZE SUMMARY \*\*\*

AGE (MOS.)	NR SAMP	AGE (MOS.)	NR SAMP	AGE (MOS.)	NR SAMP	AGE (MOS.)	NR SAMP
50	5	92	2	120	20	148	15
50	5	93	4	121	40	149	9
50	10	94	7	123	20	150	5
59	5	95	4	124	15	151	5
60	5	96	3	126	6	152	5
61	15	98	1	127	3	153	5
62	10	99	1	128	12	155	5
62	10	101	10	130	6	156	10
64	10	102	11	131	11	158	30
65	10	103	15	132	19	159	5
66	10	105	10	133	25	160	5
67	11	106	5	134	14	161	15
68	5	107	20	135	17	163	5
70	2	108	30	136	11	164	5
69	4	109	35	137	21	165	10
69	4	110	40	138	3	166	25
70	16	111	25	139	9	167	10
70	25	112	35	140	15	168	15
71	1	109	35	141	9	169	5
82	14	110	35	142	18	170	10
82	16	111	30	143	12	171	15
84	25	112	20	144	8	173	10
85	32	113	15	145	16	174	5
86	19	114	35	142	18	170	10
87	21	115	30	143	12	171	15
88	22	116	20	144	8	173	10
89	25	117	15	145	16	174	5
90	13	118	40	146	18	181	10
91	11	119	10	147	3	184	5

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WING 266 HARDNESS SHORE C INITIAL TP-H1043 PROPELLANT

This sample size summary is applicable to figures 13 and 14

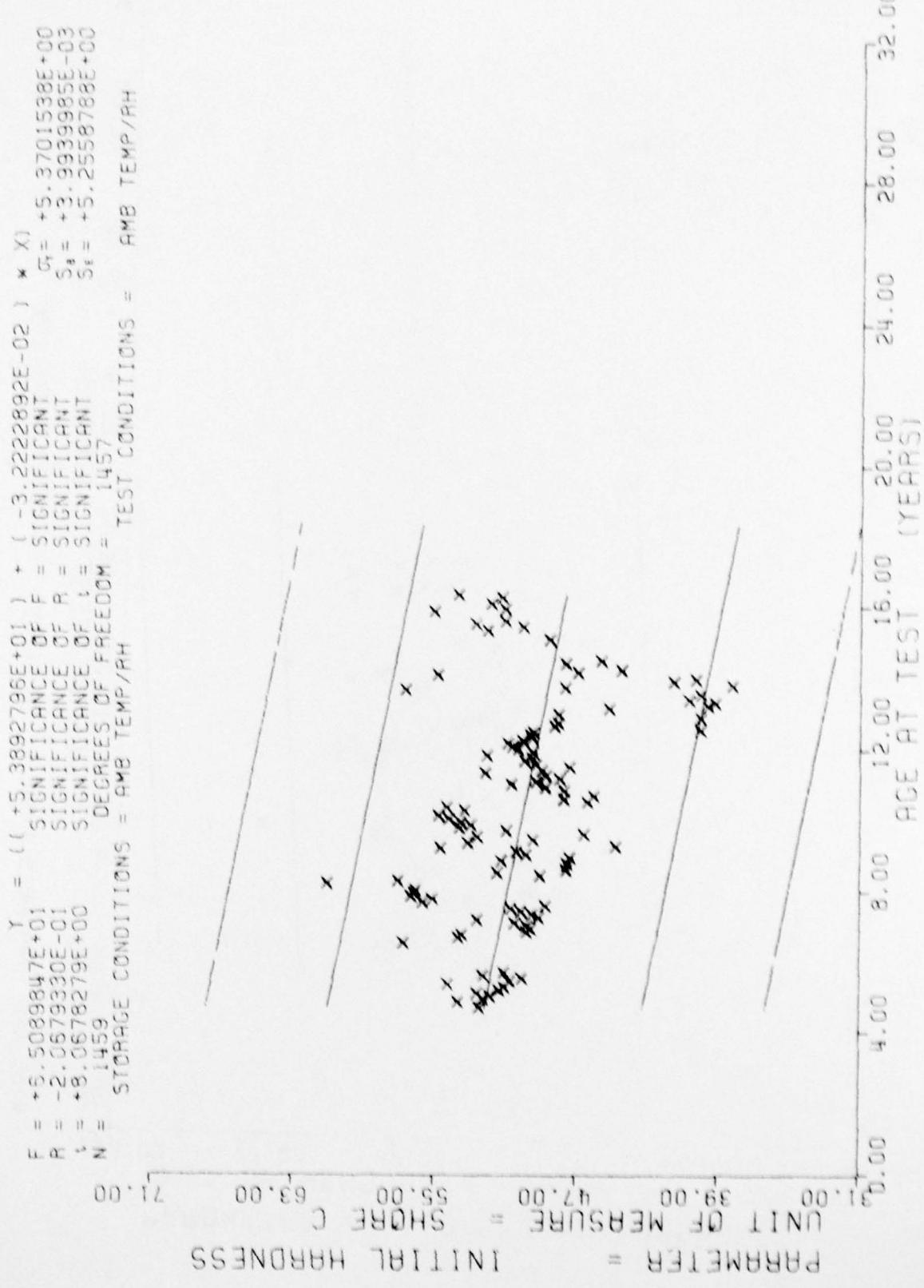


Figure 13

$Y = ( +3.5333446E+01 ) + ( -7.8588042E-03 ) * X$   
 SIGNIFICANCE OF F = SIGNIFICANT  
 SIGNIFICANCE OF R = SIGNIFICANT  
 SIGNIFICANCE OF t = SIGNIFICANT  
 DEGREES OF FREEDOM = 1457  
 TEST CONDITIONS = AMB TEMP/RH  
 STORAGE CONDITIONS = AMB TEMP/RH

PARAMETER = 10 SECOND HARDNESS  
 UNIT OF MEASURE = SHORE C  
 22.00 27.00 32.00 37.00 42.00 47.00

WINC 246 HARDNESS SHORE C 10 SECOND TP-H1043 PROPELLANT

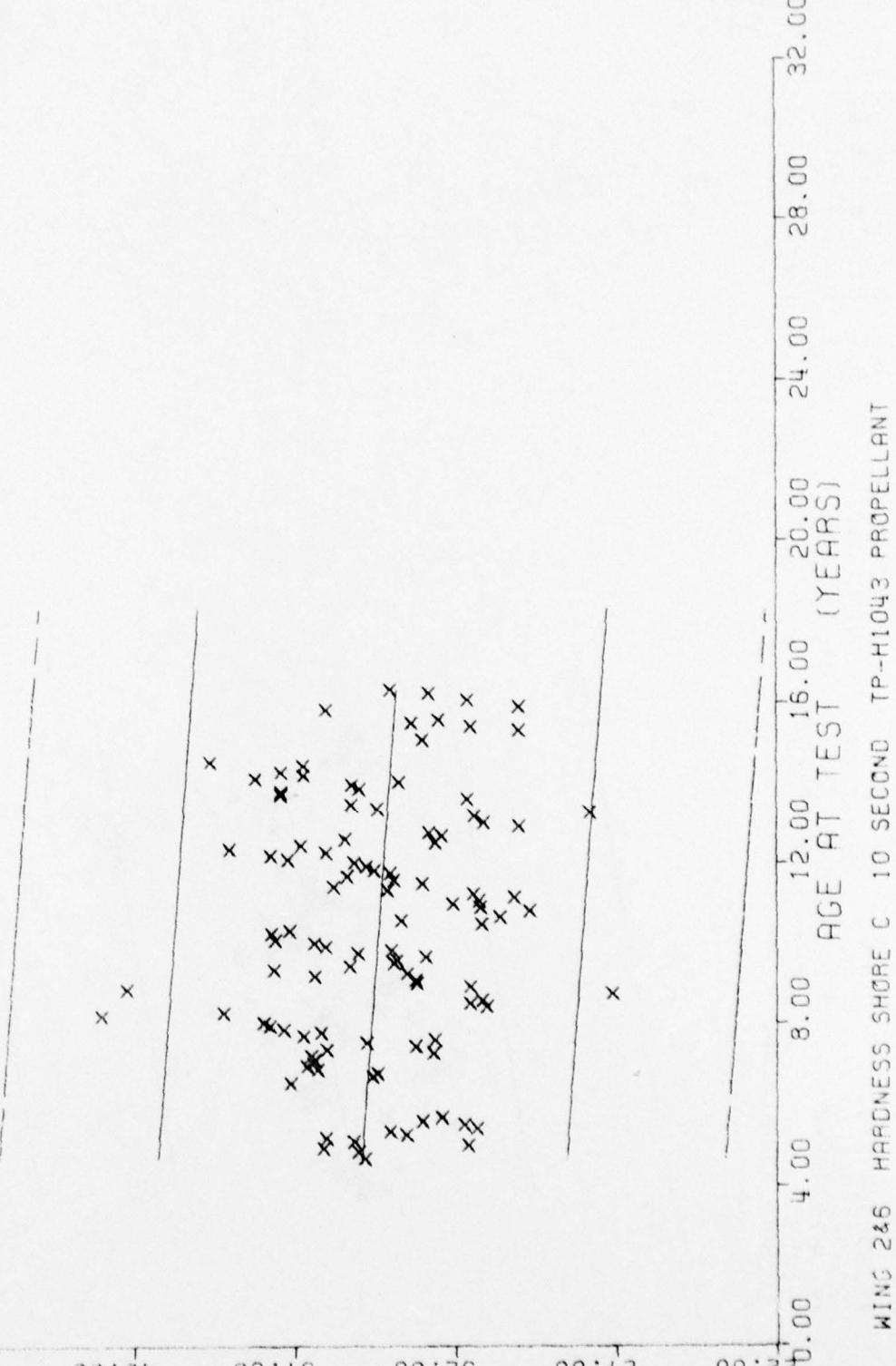


Figure 14

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7. AUTHOR(s)  John A. Thompson	8. CONTRACT OR GRANT NUMBER(s)	
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  Solid Propellant Minuteman Aft Closure		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  This report contains propellant test results from cartons of TP-H1043 propellant representing selected batches used in the aft closure of First Stage Minuteman Motors. Data from TP-H1043 propellant obtained from the aft closures of the LGM-30 A, B, F and G Motors are reported in regression analyses for the fifth time and the fourth time using the G085 computer system. Testing was accomplished in accordance with MMWRME Project M82934C. An analysis of all parameters indicate that no significant degradation is		

anticipated for at least two years past the oldest data point.

Each point on the regression plot represents all samples at that particular age. The number of samples at each point is indicated on the sample size summary sheet on the page accompanying each regression plot. The data range at any age can be found by suitable inquiry of the G085 system.